the area, and was so arranged that the sensory surface seemed to dip away sideways under the cuticle of the claw, and could then be followed under the microscope through the base of the claw into the next joint. The lower ventral edge of the exposed part of the sensory organ was protected by hairs regularly arranged so as to slant over the delicate surface, while dorsally, where the sensory surface disappears under the cuticle, the slit-like opening is guarded by a regular row of fine hyaline hairs, which rise from the sensory surface and curve over the outer cuticle. Apparently similar hyaline hairs can be focussed down in the lower parts of the invagination. On both old and young curious hairs with heads like narrow dentate leaves occur at each end of the sensory area*.

The finer histological details of this organ in *Phrynus* can only be made out in young specimens when the chitin is not too thick for sectioning. I reserve further details of the organ in *Galeodes* for a comprehensive work which I am now preparing on this animal.

The presence of this presumably olfactory organ in such different Arachnidan types as *Galeodes* and *Phrynus* is of no small interest. The clarified pedipalp of *Scorpio* showed no trace of such olfactory organs. The same must be said of a Chernetid, apparently an *Obisium*, which had been boiled in caustic potash. The pedipalp of a *Telyphonus* was also searched in vain by clarifying rough sections. I unfortunately had no young specimens of this latter at my disposal. It seems to me not improbable that some traces of such an organ might be found in very young animals considering the apparent affinity which exists between *Phrynus* and *Telyphonus*.

Whether the peculiar sexual organs at the end of the pedipalp of the Araneids had any original connexion with such a sensory organ is a point well worth investigating.

V.—*On the Embryology of the River-Lamprey.*

By Ph. Owsjannikow †.

Modern methods, including both serial sections and also the new staining reagents, now enable us to prosecute a much

* As an index of the accuracy of Koch's figures, the position of this organ is marked by a group of hairs in the drawing of *Phrynus ceylonicus*, plate 776 in vol. x. 'Uebersicht der Arachniden-Systems.'

† Translated from the 'Mélanges Biologiques tirés du Bulletin de l'Académie Impériale des Sciences de St.-Pétersbourg,' t. xiii. livr. i. St. Petersburg, 1891: pp. 55–67.

more precise investigation in the realm of embryology than was possible in former years. Thus it may be readily understood that, thanks to these new scientific processes, many deficiencies which existed also in our knowledge of the developmental phenomena in the Lamprey are supplied by numerous fresh investigations. The new facts bring with them new questions, which have a special interest for comparative embryology. As the publication in their entirety of my investigations upon the development of the Lamprey is not immediately possible, since the exceedingly abundant material from all stages of development must be arranged in proper order, and since also the figures require much time, I have determined to give a short provisional communication, which is at the same time intended to complete the investigations which I made upon this subject nearly twenty years ago.

In the ova of lamprey larvæ, which are from 70 to 90 millim. in length, the germinal vesicle is in many cases already excentric in position. At this period of development, when the contents of the ovum are in a semifluid state, the germinal vesicle may alter its position. I have had occasion to observe in a preparation three young ova in which the germinal vesicle lay between the yolk and the egg-membrane.

The Graafian follicles are clothed with endothelial cells. At the region where the pointed angles of the cells are in contact with one another, which is usually at the upper pole of the ovum, dark spots are to be seen after treatment with nitrate of silver; these may be regarded as entrances into the lymph cavities.

The blood-vessels enter the Graafian follicle at its pointed end, at which spot the active pole of the ovum also lies within the follicular membrane. It is frequently to be observed that the tip of the ovum does not quite touch that of the follicular membrane, while everywhere else the latter is in close contact with the ovum.

In all ova of lampreys which were ready to spawn when they were removed from the ovaries I have observed the germinal vesicle with the greatest distinctness in sections. The germinal spot, however, was not present. On the other hand, in very many ova which were squeezed out of the female for the purpose of artificial fertilization the vesicle could not be detected. In very few cases did it lie near the active pole of the ovum as a small flattened disk of the vitelline membrane. It is hardly open to doubt that in the cases in which the ovular nucleus is not visible its contents have mingled with the elements of the yolk, for all the ova were capable of being fertilized and in all the protoplasmic protuberance was noticeable directly after the act of fertilization.

In order that the several portions of the embryo shall be more readily distinguishable from one another, it is necessary for the preparations to be thoroughly stained. The prevalent idea that the egg-membrane is impervious to stains is erroneous. I found that several staining-fluids penetrate the ovum and the embryo. The ova took the best stain, no matter whether at first treated with Flemming's fluid, alcohol, or osmic acid, by being immersed for from twelve to four-and-twenty hours in a strong saturated solution of hæmatoxylin. A longer immersion causes the yolk-granules to become coal-black.

I possess a large series of sections in which there may be seen all those processes which set in immediately after fertilization, and were observed and described in living ova by A. Müller, Kupffer, Benecke, Calberla, and myself.

By treatment with osmic acid the contents of the ovum are instantaneously hardened, so that in sections we are enabled to get a good view of the protuberance which arises at fertilization as well as the protoplasm, which usually appears on the withdrawal of the yolk from the egg-membrane.

Moreover, in the serial sections we may study the most varied forms of mitoses, which appear at the division of the nucleus before the formation of the new yolk-segments.

The time occupied by the various metamorphoses in the ovum depends upon the temperature at which the fertilized ova are kept. This fact explains why the divisions of the yolk which I previously described in the ova of the lamprey proceeded more rapidly than they were found to do by Calberla. Kupffer states that at Königsberg, when the temperature of the air stood at from 8° to 10° C. (46°·4 to 50° F.), the larvæ were hatched on the sixteenth or seventeenth day, and at Naples at the end of the eighth day. My larvæ hatched out on the ninth or tenth day at an atmospheric temperature of about 16° R. (68° F.).

The first furrow is a longitudinal one, which consequently has a meridional direction and divides the yolk into two perfectly equal portions.

The furrow begins from the nucleus, which for a long time lies almost entirely superficially in the neighbourhood of the active pole.

The first segmentation proceeds exceedingly slowly. We observe long fibres radiating from the nucleus, which are especially distinct and lie closer together at the spot at which the furrow has begun to form.

Before the complete separation of the two segmentation spheres several nuclei appear, and between every two nuclei a spindle becomes visible. It is no doubt partly owing to such a complete separation of the yolk-segments that in the last days of development we find within one egg-membrane two embryos entirely separate from one another, as I frequently had occasion to observe.

The second furrow is likewise longitudinal, and it is only the third that is the first equatorial one.

After fifteen hours the ovum is represented by a vesicle the upper wall of which consists of a series of smaller cells, the lower of much larger ones. Baer's cavity has attained considerable dimensions.

The ova of twenty-eight hours likewise exhibit at the roof of Baer's cavity a single layer of cells.

At the lower pole, however, there lies a group of larger cells. The transition between the smaller cells of the upper pole and the larger cells of the lower is a gradual one.

In ova of fifty-five hours Baer's cavity has reached a still larger size.

The smallest cells lie at the upper pole and already have an epithelial character about them. In many sections the ovum has the appearance of a ring, which at one spot, namely at the upper pole, consists of one layer, while it is bi- or trilaminate at the other. Sometimes there lies at the lower pole a small group of segmentation-spheres. Even at this period a Rusconi's pit is visible upon the under surface of the ovum. The cells of the outer layer gradually pass into the floor of the pit. The shape of this pit leads us to suppose that it has arisen by the invagination of the outer layer, as is actually the case. This structure is nevertheless a transitory one; at any rate its appearance very soon changes. The largest cells are found in the pit of Rusconi and at its margin.

When eighty hours have elapsed the outer layer has undergone still further modification; the cells have become still more cylindrical and have almost entirely consumed the yolk-granules. The size of the segmentation-cavity has in the meantime greatly diminished. The whole of the lower half of the ovum consists of small round cells, which, however, are separated by a slight space from the still smaller and much more closely packed cells of the epiblast. The anus of Rusconi can at this time be seen with great distinctness at the lower pole, though it has undergone a change in form and has become narrower and longer. The ovum itself has also grown longer and has become pointed at one end. This latter appearance is due to the fact that during this period the multiplication of cells proceeds with especial activity at the upper lip of the anus of Rusconi at the point where the upper layer passes into the lower.

Since during this period—it may be some hours earlier, though usually later—many highly interesting processes take place in the ovum, we will now consider these more closely.

The Formation of the Alimentary Canal.

In earlier stages the anus of Rusconi took the shape of a broad pit which had arisen by invagination of the epiblast. I am speaking of an embryo which is at least some four-and-twenty hours younger than that represented in Scott's fig. 10, *a*. At that period we actually have a gastrula before us. In a few hours, however, the number of the yolk-spheres lying at the bottom of the ovum has considerably increased. The diminution in the size of Baer's cavity during this time is not to be ascribed to the fact that the cells are thrust into it by the formation of the enteric cleft, but to the increase in the number of these cells.

The formation of the enteric cavity proceeds by a splitting off of the vitelline elements from the undifferentiated cells, which become the hypoblast ("von dem Drüsenkeim"), starting from Rusconi's pit, precisely as this process has often been observed and described in the frog, axolotl, and sterlet. In the animals just mentioned this process is easier to observe, because the cells which adjoin the cleft contain pigment-granules during their division and separation from the remainder of the yolk. In some cases a streak of pigment precedes the cleft. Since the ova of *Petromyzon* are entirely unpigmented, observation becomes somewhat more difficult. In spite of this we can convince ourselves by the examination of hundreds of preparations that the lower layer, the endoderm, arises by the separation of a series of cells from the yolk. It is further to be remarked that before the formation of the enteric cleft the sections already show a special grouping of the cells which are subsequently utilized as the elements of the lower layer. During this period and also somewhat later two layers, the ectoderm and endoderm, are present, which are separate from one another and continuous only at the point of flexure. The cells of the ectoderm are smaller than those of the endoderm, as is indeed perfectly natural, since the development of the former commenced earlier than that of the latter.

After this the chief centre of the developmental processes is situated for a time in the hinder portion of the embryo. In successful longitudinal sections, namely such as pass through the middle of the ovum from front to rear, so that they bisect the upper and lower lips of the anus of Rusconi, it can be seen that the embryo already extends over half of the ovum. It consists, as already stated, of ectoderm and endoderm, and each of these layers exhibits only a single series of cells throughout its entire extent. It is true that sections are to be found in which the ectoderm has more than one series of cells, but this is owing to the fact that the sections were taken obliquely and that the knife, working more on the surface of the ovum, has carried a larger strip of this with it. I have found preparations in which the enteric cleft communicated with the segmentation-cavity. The cells which were situated at the periphery of the cavity, immediately beneath the ectoderm, were utilized for the formation of the lower layer.

Ova 118 hours after Fertilization.

Ova belonging to this period exhibit but little difference from those of the preceding one. They have become somewhat longer; the two lips, the upper and the lower, and the plug which lies between them are still more distinct, and the embryo itself has still further increased in length. In many longitudinal sections each of the two layers continues to exhibit a single layer of cells. On the other hand, many transverse sections, if they have passed through the posterior end of the ovum, exhibit a multiplication of the ectoderm cells beneath the dorsal furrow. The spinal cord is in process of formation: as Calberla has already shown, this structure is at first solid, and it is not until later that the cells separate from one another and give rise to the spinal canal.

Ova 126 hours after Fertilization.

This is one of the most interesting periods. The embryo has become considerably longer. In very many transverse sections of the ovum the embryo is cut through in two places, at the anterior and posterior end. At the latter we observe the solid spinal cord, beneath which is the notochord already completely developed, and then the epithelium of the enteric canal, which forms its inner wall. On both sides of the notochord lie in part still solid rudiments of the protovertebræ, Wolffian ducts, and lateral plates; the latter pass into a single layer. A section taken through the anterior portion of the embryo presents another picture. At this point the central nervous system is thicker: a central canal has already developed at some distance from the brain, the anterior end of which is also still solid. At this region the notochord is not present, though the cells of the endoblast immediately adjoin the central nervous system. At some distance from the anterior end of the embryo the enteric cavity is of a very considerable size. It is surrounded above by a double layer of endoblast cells, which are somewhat thrust downwards in the middle by the spinal cord. On the other hand, on both sides of this depression, to the right and left of it, the endoblast forms an upward expansion of the cavity. If we now examine the sections in order from behind forwards, we observe two folds of the endoblast approaching nearer and nearer to the middle line. In this manner two cavities appear, the uppermost of which is the smaller. Finally the folds completely meet, forming a ring round the smaller cavity, which at last entirely disappears.

In the remainder of the body the formation of the notochord appears to take place by a simple constricting off of the endoblast cells lying beneath the spinal cord, as has already been described and figured by Calberla. On both sides of the notochord lies a double row of cells, which soon passes into a single one. These cells have separated from the endoblast. There is no space between the two rows; but in spite of this we already recognize the elements which will go to form protovertebræ, Wolffian ducts, and lateral plates. Moreover in many sections we find the protovertebræ already almost completely developed: the formation of a cavity in them takes place later on. The epiblast, too, during this period is still exclusively unilaminate except in the median line, where the spinal cord has already developed. In the sections it is still sometimes entirely separate from the ovum.

The development of all primitive organs is further advanced in the posterior than in the anterior portion of the embryo. The formation of the cavities and canals is effected either by the separation of the cells from one another or, as is especially the case in the region of the undifferentiated cells which become the hypoblast, by the consumption of the yolk-lamellæ, so that in the place of the yolk-cells only empty envelopes remain.

Development proceeds from the median line towards the sides. After the formation of the spinal cord and the notochord a cavity arises, first in the protovertebræ, which separate from the rest of the cells of the mesoblast, then in the Wolffian ducts, and finally in the lateral plates. It is asserted by A. Shipley (fig. 11) that the Wolffian ducts or the segmental organ develop before the protovertebræ. I have seen no evidence of this in my preparations. The figure in question is altogether too diagrammatic.

The protovertebral segments are not cubical, but are drawn out into a point at the lower inner angle towards the notochord.

On the Origin of the Sense-Organs.

I have not observed the formation of the auditory apparatus in embryos less than 160 hours old. There appears at the side of the brain a pit-shaped invagination of the ectoderm which is equally distinct in transverse as well as in longitudinal sections. The cells which are situated in the centre of the pit are somewhat longer than the remainder. After some time the pit closes and becomes a capsule, the future labyrinth of the auditory apparatus. At this period all cells, both of the skin as well as of the nervous system, are still pretty richly packed with yolk-lamellæ. The intermediate space between the auditory capsule and the brain is very inconsiderable, and subsequently almost completely disappears.

The formation of the eye takes place during the two hundredth to the two hundred and fortieth hour after fertilization. At the side of the upper surface of the fore brain, almost immediately behind the olfactory pit, we find a sac-shaped expansion of the cerebral wall. It extends backwards and downwards, and can be better seen in longitudinal sections, though in order to obtain a complete representation of it both classes of sections must be examined. At first the cavity of the saccule is exceedingly narrow, but it subsequently becomes somewhat wider, especially at its outer end.

The earliest rudiment of the paired eyes in the lamprey presents more similarity to the rudiment of the third eye in many animals than to that of the eyes of the Vertebrata in general. For in this case we find a relatively long tubular stalk, the outer and somewhat expanded end of which is only utilized for the formation of the retina. The outer wall of the eye-stalk grows thicker and becomes indented like a pit, just as the retina is generally developed. The epithelium of the skin, which lies opposite the rudiment of the eye, takes no part in its formation. During this time no trace of the lens can be discovered.

The formation of the nasal pit proceeds by a pit-shaped invagination of the outer layer, as has already been frequently described.

The whole of the earliest sense-organs appear to have arisen in the same manner throughout the entire Vertebrate phylum.

The Heart.

I have observed the earliest rudiments of the heart, or, rather, of the venous vessel in embryos of the age of 133 hours. The longitudinal section taken from above downwards exhibits an arrangement somewhat similar to that figured by A. Goette in his well-known work on the development of the fire-bellied toad (fig. 37); for we observe that the enteric cavity has attained its greatest dimensions in the region of the head, which is in process of formation. Posteriorly towards the dorsal surface it becomes narrower and forms a very slight indentation in the middle of the undifferentiated hypoblast cells, and then proceeds as a sac-shaped depression in the yolk in the direction of the ventral surface. The walls both of the enteric cavity and of the venous sinus are clothed with cells of the endoblast, which as yet are far from having assumed an epithelial character. They are large and full of yolk-granules. At this period we have only the cavity of the vessel before us, which subsequently becomes constricted off from the intestine. The appearance of the rudiment of the venous system alters very little during the next forty or fifty hours.

In embryos of 180 hours the body has attained a considerable length. In longitudinal sections we observe the branchial cavity in the form of a long canal which already possesses gill-slits. Below the branchial cavity there appears, as in the previous stage, a depression passing off in a lateral direction from the intestine. It has in the meantime become somewhat longer and its lower end less regular. As a matter of fact it is continued in the shape of a cleft, which can be traced a very long way backwards, while rifts may be observed proceeding from it in all directions, which finally lose themselves between the yolk-spheres.

It is evident from what is here seen that long before the development of the heart we have a system of canals which are filled with a fluid—the lymph. In all the cavities mentioned, in the cavity of the intestine, the branchial chamber, &c. we find circular rings, a kind of membranes, which are probably remnants of yolk-spheres which have undergone dissolution. Isolated channels of this kind are to be met with in which some few yolk-granules are still present, while others are quite full of them. The granules are much smaller than the neighbouring cells or yolk-spheres of the undifferentiated hypoblast. We may consider that the yolk-spheres during the period which is now being described are on the average from nine to ten times larger than the granules alluded to: the size of many of them, however, is greater than this.

Further and more important changes, which already stand in direct connexion with the formation of the heart, are to be noted in embryos of from 200 to 220 hours, when they have attained a length of from 2 to 3 millim. Beneath the branchial cavity an expanded oval region is formed, just as if the embryo was somewhat swollen at this point. The longitudinal sections show that a wide cleft has here appeared in the lateral plates on the right and left: the outer layer applies itself to the skin, the inner one to the intestine. We then have on both sides of the intestine two oval vesicles, the greatest diameter of which lies in the vertical direction. The formations just described vividly remind us of the pleural sacs of the higher Vertebrates before the appearance of the lungs. In certain sections they appear quite empty; in others, taken higher up, we find the rudiments of the segmental organs, that is of the primitive kidneys.

In order to obtain a distinct representation of the development of the heart, we must have recourse to transverse sections. If we examine one of these from the cardiac region, we observe round the œsophagus a wide free space, which has been formed by the divergence of the two lateral plates: this is the body-cavity. We employ this term in order to apply a general idea to this cavity. The intestinal fibrillar plate (" Darmfaserplatte "), or splanchnic mesoblast, can be traced particularly well in stained sections. We observe a fold of it on the right, as also on the left side, which passes round the segmental organs and the upper half of the œsophagus. When the two layers meet beneath the closed œsophagus they assume a downward direction, and finally pass into the somatic mesoblast, which attaches itself to the ectoderm. At the spot at which the right and left fibrillar plates have approached one another—namely, where the two portions lying between the splanchnic and somatic mesoblast are opposite to one another—there is at first a narrow, and subsequently a much broader cleft, which extends from above downwards. This intermediate space is the cardiac cavity. The above-mentioned portions of the intestinal fibrillar plates had fused together at their upper and lower margins and become a closed tube, which now projects freely into the body-cavity and is attached to the intestine by a short band. Before the fusion of the median portion of the intestinal fibrillar plates to form the cardiac walls, there could already be observed on their inner margin a special layer of flat cells. This internal layer of cells separates from the external one; and in the transverse sections we have before us two tubes lying one within the other. The internal one becomes the endothelial coating of the heart—that is, the endocardium. The second, somewhat stouter tube becomes the muscular tissue of the heart, which on the outside is likewise clothed with endothelial cells. The heart in *Petromyzon* arises from the folds of the intestinal fibrillar plates, which alone furnish the material for all its constituent parts. I would especially point out that the elements of the intestine take no share whatever in the formation of the heart. A communication is established between the cardiac cavity and those lymph-chambers which we designated above as the commencement of the heart, and which have transformed themselves into the veins. At this period the veins have no walls of their own, and are in communication with many canals and lacunæ.

Though the literature of the subject will not be fully considered until my detailed and illustrated paper is printed, I cannot here refrain from mentioning that A. Shipley's observations with reference to the heart also are highly valuable. His figures (figs. 24 & 26) are faithful representations, albeit somewhat diagrammatic. At the time of the earliest formation of the heart the endothelium on the intestinal fibrillar plate cannot be seen with the distinctness with which it is shown in the figure.

Since the formation of the heart is one of the most difficult processes which embryology has to study, I would like to add a few more words to the results above described. According to an observation by P. Meyer, as communicated in his article "Ueber die Entwickelung des Herzens und der grossen Gefässstämme bei den Selachiern," the endocardium arises in a manner different from that which we have explained. This author states that when the intestine closes the two lateral veins apply themselves together beneath it, and unite into one vessel, to provide the heart with a single unpaired tube—an "endothelial saccule." The figures (Tab. 12. fig. 2, and others) which P. Meyer has given us entirely support his view; and in the embryology of the lamprey also we actually find a series of preparations which appear to confirm it. For it is an exceedingly striking fact that the endothelial saccule of the heart often lies at a great distance from the myocardium, as if it has arisen independently and has been in no way connected with the lateral plates. Moreover, we find the cardiac cavity bounded by the lateral plates, without its being possible to recognize distinctly the endothelium on their inner surface.

Then, too, preparations occur in which the lateral plates have not yet completely surrounded the lower surface of the intestine; their two layers lie close together and more towards the periphery, and yet in the middle of the body-cavity we find an endothelial pellicle belonging to the future endocardium. In spite of all these appearances I consider that I am bound to adhere to the opinion that the endocardium has separated off from the lateral plates on the inner surface precisely in the same manner as on the outer. I find myself compelled to do this by the arrangements presented by quite young stages of the embryos, measuring about 2·5 millim. in length. The endocardium is here visible in all sections taken in the cardiac region, but always in the closest connexion with the myocardium. Both membranes appear thick, and are richly provided with yolk-granules.

Before closing this division of my paper, I must not pass over in silence the statements of A. Goette, since they are at variance with my observations. According to this author, the endocardium is formed from endoderm. Since it is difficult to suppose that so capable an investigator as Goette should have been mistaken, the material investigated must have been of such a kind as to admit of what was seen being interpreted in a different fashion. Goette's view might be supported by the circumstance that in the neighbourhood of the rudiment of the heart the œsophagus is rather strongly compressed at the sides, and almost touches the ectoderm with its under surface. When the formation of the heart has taken place, the lumen of the œsophagus has diminished by one half. Isolated cells are then not infrequently to be found in the upper angle formed by the contact of the intestinal fibrillar plates. A constriction of the œsophagus, as has sometimes been described, or a splitting-off of a series of cells from its under surface for the benefit of the endocardium, I have never seen, and I therefore adhere to the assumption which I have stated above.

The Endoblast.

The branchial cavity arises by the separation of the cells of the yolk at the anterior end of the embryo, in the manner which we have had occasion to observe in the formation of the intestine. The great thick head, consisting of a compact mass of cells, commences to recede somewhat from the yolk, and becomes smaller and narrower. Between it and the yolk the anterior portion of the body of the embryo becomes continually more distinct and longer. The internal changes proceed hand in hand with the external ones. The cavity which has been formed, which was at first more spacious at the anterior end, gradually also extends backwards in similar dimensions. The entirely undifferentiated cells surrounding the cavity assume an epithelial character. In the canal which becomes the branchial cavity lateral evaginations appear, which extend from in front backwards. The evaginations become so pronounced that the endoderm cells come into contact with the epithelium of the integument, which is finally absorbed. Opposite the evagination a slight depression is sometimes noticeable. At certain spots it seemed to me that the epithelium of the future slit has thrust itself so far outwards that the cells of the epidermis here appear thinner. The groove which arises on the under surface of the branchial cavity, in the neighbourhood of the first to the fifth slit, and which subsequently becomes for the most part closed off—the thyroid gland—has been described very frequently, and I have nothing material to add. The main features of the formation of the mouth, the union of the ectodermal pouch with the endoderm of the branchial cavity, are likewise well understood. If we examine a few longitudinal sections, which were made parallel to the ventral surface of the embryo, pretty much such as those which are shown by A. Dohrn in his plate iv. (Bd. vii.), we are struck by the similarity between the gill-slits and the two outer angles of the oral pouch. It seems as though the latter are only the end of the series of those slits. The similarity appears not only in the position, but also in the form.

The liver is formed by evaginations of the intestinal wall. We observe that this is in connexion with canals, which soon become converted into tubes. At the spot at which these processes are taking place the intestine is less abundantly surrounded by yolk-cells than in its posterior division. At all events the yolk-cells take no part in the formation of the liver. In spite of Kupffer's statement that a neurenteric canal is not formed in the Lampreys, I must most emphatically insist upon its occurrence in these animals, though it is true that at present not a single satisfactory drawing of it exists.

If we follow the spinal cord in longitudinal sections, we see with the greatest distinctness how the end of it bends round the notochord, and then runs for a space beneath it, to end as a somewhat thinner cord in the upper wall of the end-gut above the anal opening. My preparations were stained with hæmatoxylin, and the cells of the spinal cord (as also the neurenteric canal) appeared very dark, in consequence of which they stood out from the rest. The cells were, moreover, much larger than others lying in the neighbourhood, such as, for instance, those of the epithelium. The shape of the canal in question is somewhat obscured, owing to the fact that a large venous vessel lies near it.

The Brain and the Ganglia.

In a provisional communication, which is not accompanied by figures, very little can be said as to these organs. Some days before the embryos are hatched the brain already possesses several divisions. During the formation of the optic vesicles the anterior wall of the fore brain is represented by a very thin lamella. The hemispheres and the olfactory lobes are developed afterwards. The hypophysis originates from the ectoblast, while in almost all other animals it is formed from the cells of the endoblast.

As to the epiphysis, I have made certain statements in the paper which has recently appeared on the third eye of the Lampreys. All ganglia (of the head, as also of the trunk) are produced from the cells of the ectoderm. The cerebral ganglia appear to arise at a very early stage. They subsequently separate from the epidermis, and appear to be related to the mesoblast. In embryos of from 2 to 3 millim. in length, however, we still find them in connexion with the integument. The spinal ganglia arise later on, and not above the spinal cord, but to the side of it. I have observed epithelial cells extending inwards from the skin like a plug between the protovertebræ. At a subsequent period they lay near the spinal cord, already separated from the skin, and forming a roundish independent group. From the spinal cord there proceeded a short fascicle of nerve-fibres—that is, a root—in the direction of the ganglion-cells. A junction between them was not as yet established.

In concluding this short communication I cannot refrain from mentioning that the description and figures by A. Dohrn of the cerebral ganglia (as, for instance, those of the trigeminus, ophthalmicus, facialis, vagus, and other nerves) are in the highest degree true to nature. I possess a large series of preparations, which show precisely the same picture as his figs. 1, 2, & 4 of pl. 10, and especially fig. 6 of pl. 11 (Bd. viii. Heft 2).

VI.—*Notes on* Apteryx Haastii.

By Walter Rothschild.

Mr. Forbes has expressed it as his opinion that *Apteryx Haastii* is a natural hybrid between *A. australis* and *A. Owenii*. I have paid much attention to this question as well as to the study of this genus generally, having had during the last four